DOCUMENT RESUME

ED 177 003 SE 029 115

AUTHOR Lombardi, Alice D.
TITLE Minimum Standards of Pupil Perfcrmance: Mathematics, Grades K-9. Experimental Curriculum Bulletin, March 1979.
INSTITUTION New York City Board of Education, Brocklyn, N.Y. Div. of Educational Plannirg and Support.
PUB DATE 79
NOTE 49p.; Not available in hard ccpy due to copyright restrictions
AVAILABLE FROM Center for Curriculum Development, Division of Educational Planning and Support, 131 Livingston Street, Brooklyn, New York 11201 (no price quoted)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Academic Standards; Educational Objectives; *Elementary School Mathematics; Elementary Secondary Education; *Mathematics Curriculum; Minimum Competency Testing; *Performance Based Education; Performance Criteria; *Secondary School Mathematics; Standards
IDENTIFIERS *New York City

ABSTRACT

This experimental curriculum bulletin, published by the Board of Education of the City of New York, contains lists of mathematics performance objectives necessary for pupil competency at each level (K-9). A short introduction explaining how the objectives should and should not be used, and a memorandum to community school board presidents, superintendents, and principals asking for evaluation of the objectives are included. (MK)

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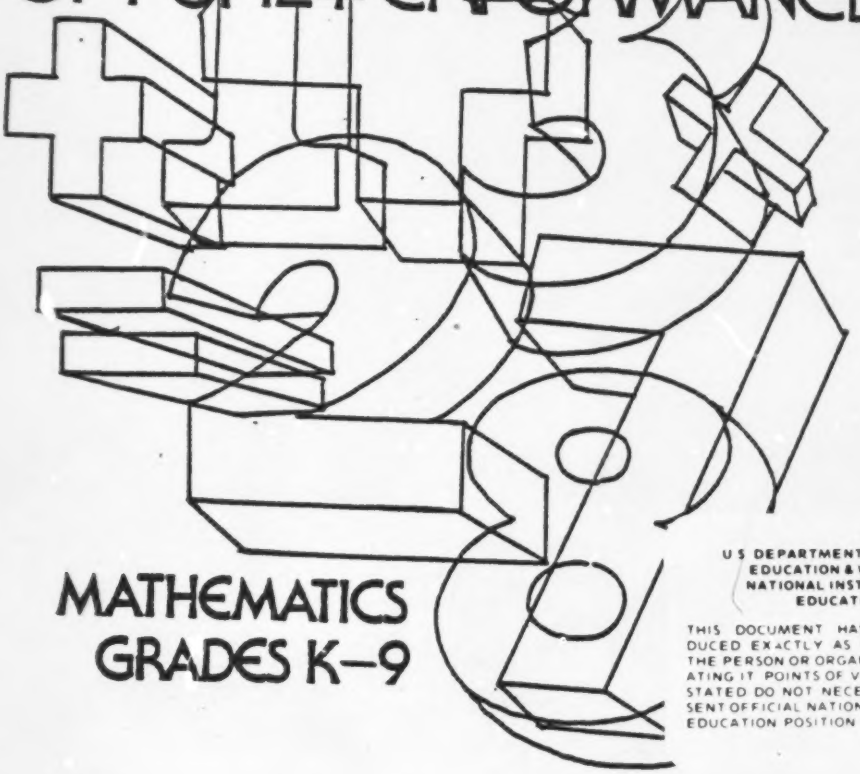
MINIMUM STANDARDS

OF PUPIL PERFORMANCE



MATHEMATICS GRADES K–9

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ARNOLD WEBB
EXECUTIVE DIRECTOR

212-596-6026

March 29, 1979

DIVISIONAL MEMORANDUM NO. 29

TO: Community School Board Presidents, All Superintendents, Principals of All Day Schools

FROM: Arnold Webb Webb

SUBJECT: Curriculum Bulletin, Minimum Standards of Pupil Performance: Mathematics, Grades K-9

The experimental curriculum bulletin, Minimum Standards of Pupil Performance: Mathematics, Grades K-9, presents for teachers and supervisors a listing of learning objectives which are necessary for pupil competency at each grade level. These listed objectives form the basis for an instructional program which will enable pupils to meet minimum competency requirements and to continue the study of mathematics. This selection of sequenced objectives is supported by current national research and by the classroom expertise of New York City educators in the field of mathematics.

On the basis of your professional judgment and experience, please evaluate the bulletin in terms of the following:

1. Is the scope adequate for each grade level? If not, what additional objectives should be included?
2. Are reasonable standards being set for the students? If not, please specify.
3. What additional comments would you make? We would like to get your reaction to various aspects of the bulletin, such as, the format, the value of this listing, and the clarity of performance objectives.

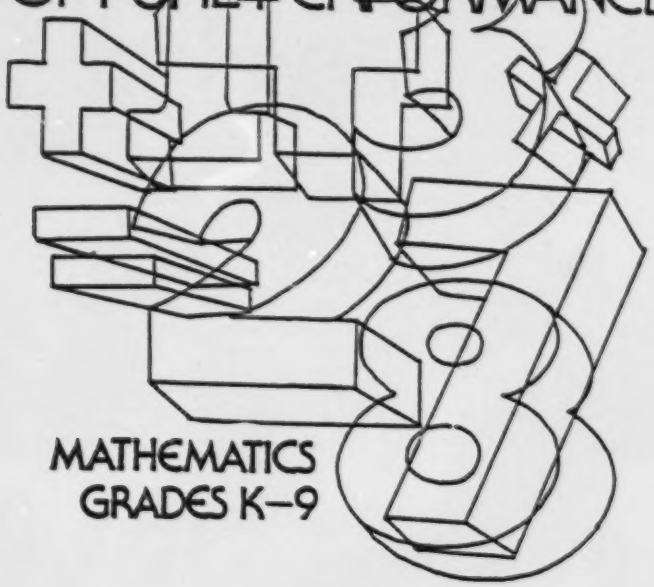
Your comments will serve as a basis for revising this experimental edition. We value and appreciate your participation. Please send your evaluation on or before June 27, 1979 to:

Ms. Charlotte Frank, Acting Director
Center for Curriculum Development
131 Livingston Street
Brooklyn, New York 11201

CF:gb
cc: Curriculum Council Members
District Mathematics Coordinators

MINIMUM STANDARDS

OF PUPIL PERFORMANCE



MATHEMATICS
GRADES K–9

EXPERIMENTAL CURRICULUM BULLETIN • MARCH 1979
BOARD OF EDUCATION OF THE CITY OF NEW YORK
DIVISION OF EDUCATIONAL PLANNING AND SUPPORT

ACKNOWLEDGMENTS

This preliminary edition of Minimum Standards of Pupil Performance: Mathematics Grades K-9 was developed as a project of the Division of Educational Planning and Support, Arnold Webb, Executive Director.

Charlotte Frank, Director (acting), Center for Curriculum Development, and Frank J. Wohlfort, Assistant Director of Mathematics, Center for Mathematics and Science, provided overall supervision.

The writer directly responsible for planning, researching, designing, and writing this document was Alice D. Lombardi, Mathematics Specialist, Center for Mathematics and Science.

Special acknowledgment and appreciation is made to the following developers and writers of the preliminary draft of pupil learning objectives for the specific grades of this publication.

Grades K,1,4,5,6

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Grades 7,8 and 9 (Pre-Algebra and Algebra)

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Harriet Haynes	Teacher, J.H.S. 88M

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INTRODUCTION

Minimum Standards of Pupil Performance: Mathematics Grades K-9 presents for teachers and supervisors a listing of learning objectives which are necessary for pupil competency at each grade level. This selection of sequenced objectives is supported by current national research and by the classroom expertise of New York City educators in the field of mathematics.

For effective use of this document teachers and supervisors should understand how it relates to the entire mathematics curriculum, and to the mathematics component of Minimum Teaching Essentials: Grades K-9. The full mathematics curriculum includes much more than is involved in either the Minimum Teaching Essentials or Minimum Standards of Pupil Performance. The former publication presents by grade what must be taught, not necessarily what must be mastered by the pupils to whom it is taught. Minimum Standards of Pupil Performance specifies what pupils must learn in order to proceed to the next level of each strand of mathematical concepts and skills. Its listed objectives thus constitute the central core of the comprehensive mathematics curriculum as illustrated below.

In each grade the basic objectives are organized around the same topics as those presented in the New York City mathematics curriculum bulletins. However, the order of performance objectives in Minimum Standards of Pupil Performance should not be interpreted as a teaching sequence.

It is hoped that the publication of this document will facilitate teachers and supervisors in instituting instructional programs which will not only increase pupils basic competency, but will also serve the ultimate goal of developing pupils' mathematics potential to the fullest.

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - KINDERGARTEN

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER NAMES AROUND US: READINESS FOR NUMBERS	• Observes and reads number names in the classroom, school, neighborhood • Recalls personal or significant number names • Uses number names, one, two, three, etc.
ONE-TO-ONE CORRESPONDENCE BETWEEN SETS OF OBJECTS	• Recognizes a set as a collection of objects • Names the members of a given set • Matches objects in two sets one-to-one and indicates which set has more (or fewer) elements • Recognizes, by matching, sets that have the same number of objects • Uses positional terms: up-down; top-bottom-between; inside-outside-center
PERCEIVING THE NUMBER IN A SET AND ITS SUBSETS WITHOUT COUNTING	• Recognizes the number property of a set • Demonstrates the concept of pair • Forms sets with zero through four objects and perceives the number of objects in the in the sets
PERCEIVING THE NUMBER IN A SET AND ITS SUBSETS: COUNTING, COMBINING AND SEPARATING	• Recognizes and reads the number symbols 0, 1, 2, 3, 4, 5, 6 • Observes subsets within a set of one through six objects and names the number of the subsets • Arranges sets of from zero to six objects in numerical order

MATHEMATICS - KINDERGARTEN (Continued)

- Compares the numbers of two sets
- Counts in order, one to six objects
- Recognizes doubles within an even number of objects through a total of six
- Adds one object to or takes away one object from a set of objects and names the number of the resulting set

NUMBER LINE CONCEPTS: EARLY LEVELS OF DEVELOPMENT

- Estimates and checks comparative lengths of objects
- Uses terms: longer, shorter, as long as
- Estimates and checks comparative weights of objects
- Uses terms heavier-lighter
- Measures the length of an object by matching it with a nonstandard unit

GEOMETRIC CONCEPTS AND FRACTIONAL PARTS: EXPLORATION AND EXPERIMENTATION

- Perceives equal parts of a whole
- Perceives one-half of a whole
- Divides single objects into halves
- Compares the capacity of two containers and uses terms: full, empty, one-half full
- Uses a nonstandard container to measure the capacity of containers of various sizes
- Recognizes rectangular, cylindrical and spherical objects
- Recognizes a circle
- Observes and imitates directions of the hands and numerals on a clock
- Uses terms: daytime, nighttime, on time, late, tomorrow, yesterday, today

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 1

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
SETS; NUMBER; NUMERATION	. Recognizes a set as a collection of things . Names the members of a given set . Recognizes, by matching, sets that have more than, fewer than, or the same number of members . Forms sets with one more member; one fewer member; same number of members as a given set . Arranges sets of from zero to ten objects in sequential order . Recognizes the number property of a set . Names the number of a given set, associates the symbol and the word for the number of a given set, and writes the numerals . Compares pairs of numbers through twenty . Recognizes the order of whole numbers through twenty . Groups and counts objects by ones, twos, fives, tens, to twenty . Groups sets of ten to twenty objects as tens and ones . Reads and writes the words: tens, ones . Recognizes and explains place value of the whole numbers ten through twenty in terms of tens and ones . Demonstrates the ordinal use of number

MATHEMATICS - GRADE 1 (Continued)

ADDITION OF WHOLE NUMBERS	· Joins two sets of objects and describes the new set formed · Names the number of objects in each of two sets and in the new set formed · Demonstrates addition and writes the appropriate number sentence, e.g., 2+1=3 (sums through 10)
SUBTRACTION OF WHOLE NUMBERS	· Removes a subset from a set of objects and describes the set that is left · Names the number of a given set, the number of the set removed and the number of the set that is left · Demonstrates subtraction and writes the appropriate number sentence, e.g., 3-1 = 2 (sums through 10)
FRACTIONAL NUMBERS	· Recognizes two equal size parts of a single object · Recognizes one-half of a single object · Divides single objects into halves
GEOMETRY	· Distinguishes between solid and plane figures · Uses terms: inside, outside, on, center · Recognizes tne line of symmetry by folding paper
MEASUREMENT	· Recognizes the order of the days of the week · Explains days - week relationship · Uses the terms: today, tomorrow, yesterday · Uses a clock to tell time to the hour · Compares lengths of objects using nonstandard units and uses the terms: longer-shorter; same length · Uses nonstandard units to measure the capacity of a container and uses the terms:full, almost full, empty

MATHEMATICS - GRADE 1 (Continued)

- Compares weights of objects using nonstandard units and uses terms such as: heavier-lighter
- Observes the changes in the column of liquid on a thermometer and expresses temperature in terms such as: higher-warmer; lower-colder
- Explains the relationships and the relative values of penny-nickel-dime

ALGEBRAIC CONCEPTS

- Recognizes the symbols: +, -, =
- Reads and writes number sentences

STATISTICS; PROBABILITY; GRAPHS: PROBLEM SOLVING

- Collects, organizes and explains quantitative relationships about two sets of data
- Develops original number stories
- Writes and solves number sentences for pictured, dramatized and original number stories
- Solves word problems involving addition and subtraction facts, sums through 10

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 2

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER; NUMERATION	· Names the number associated with sets of objects · Compares and orders the whole numbers less than one hundred · Estimates quantities · Counts by ones,twos, fives, and tens to one hundred · Rounds whole numbers to the nearest ten · Represents two-place numbers as tens and ones · Reads and writes the standard numeral for numbers less than one hundred · Demonstrates the ordinal use of number uses the terms: first, second, . . . tenth
ADDITION OF WHOLE NUMBERS	· Recalls and writes the basic addition facts (sums through 18) · Finds the sum of three single digit addends (sums through 18) · Computes the sum of tens and multiples of ten (sums less than 100), e.g. 20 + 30 = 50 · Finds the sum of two addends each of which is a two-digit number requiring no exchange (renaming), sums less than one-hundred

MATHEMATICS - GRADE 2 - (Continued)

SUBTRACTION OF WHOLE NUMBERS

- Recalls and writes the basic subtraction facts (sums through 18)
- Demonstrates the concept of inverse operations by writing related addition and subtraction number sentences, e.g.
  $7 + 9 = 16 \longleftrightarrow 16 - 9 = 7$
  $9 + 7 = 16 \longleftrightarrow 16 - 7 = 9$
- Computes the difference of tens and multiples of tens, e. g.
  $50 - 30 = 20$
- Finds the difference of two-digit numbers requiring no exchange, e. g.

$$\begin{array}{r} 56 \\ -21 \\ \hline 35 \end{array}$$

MULTIPLICATION OF WHOLE NUMBERS

- Demonstrates the multiplication process by joining equivalent sets of objects and tells the number of objects altogether
- Derives multiplication facts from addition sentences with equal addends: twos and fives (products through 25)

DIVISION OF WHOLE NUMBERS

- Demonstrates the division process by separating sets of two through twenty-five objects into equivalent subsets and tells the number of sets formed
- Derives division facts related to the multiplication facts, e. g.
  3 twos = 6 $\longleftrightarrow$ there are 3 twos in 6

FRACTIONAL NUMBERS

- Recognizes one-half and one-third of a whole
- Uses the fraction symbols: 1/2, 1/3

MEASUREMENT

- Estimates length, capacity, and weight
- Uses nonstandard units of measure
- Measures length and uses the metric units; meter, centimeter; the customary units: inch, foot

MATHEMATICS - GRADE 2 (Continued)

	· Tells time to the hour; to the half-hour
	· Recognizes the penny, nickel, dime, quarter and indicates their value in cents
	· Describes the relationships among the penny, nickel, dime, and quarter
	· Explains calendar relationships: days - week; months - year
	· Measures capacity and uses the metric unit liter; the customary unit quart
	· Measures weight and uses the metric unit kilogram; the customary unit pound
	· Recognizes dozen, half-dozen and describes the relationship between them
GEOMETRY	· Recognizes and names the geometric shapes: rectangle, square, triangle, circle
	· Recognizes lines that separate objects into two matching parts as lines of symmetry
GRAPHS; PROBLEM SOLVING; PROBABILITY	· Collects, organizes and explains quantitative relationships about sets of data
	· Develops original number stories
	· Interprets physical/pictorial models of arithmetic operations and writes appropriate mathematics sentences
	· Changes word problems to number sentences and solves them
	· Solves word problems involving addition, subtraction, muliplication, and division facts

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 3

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER; NUMERATION	· Recognizes numerals 0 to 1000
	· Associates the correct number word with numerals through 999
	· Compares and orders two-place numbers
	· Groups and counts by twos, threes, fours, fives, tens, hundreds
	· Reads and writes the standard numeral for numbers less than one thousand
	· Estimates a quantity by rounding numbers to the nearest ten
	· Represents a three-digit numeral as hundreds, tens, and ones
	· Recognizes and names the number of ones, tens, and hundreds in a three-digit numeral
ADDITION OF WHOLE NUMBERS	· Recalls the basic addition facts
	· Computes the sum of two-digit addends; three-digit addends requiring no renaming
	· Demonstrates the exchanging (renaming) process in addition
	· Computes sums of two addends each of which is a two-digit number, requiring exchanging ones for tens
	· Computes the sum of more than two addends, sums less than one-hundred
	· Computes the sum of hundreds and multiples of hundreds, e.g., 100 + 200 = 300

MATHEMATICS - GRADE 3 (Continued)

SUBTRACTION OF WHOLE NUMBERS	· Recalls the basic subtraction facts
	· Writes and states the subtraction facts related to the basic addition facts
	· Computes the difference of two-place numbers; of three-place numbers requiring no exchange
	· Demonstrates the exchanging process in subtraction
	· Computes the difference of two-place numbers requiring the exchange of one ten for ten ones
	· Computes differences of one-hundred and multiples of one-hundred, e.g. 300 - 200 = 100
MULTIPLICATION OF WHOLE NUMBERS	· Illustrates multiplication as a repeated addition process
	· Derives the basic multiplication facts: twos, threes, fours, and fives (products zero through forty five
DIVISION OF WHOLE NUMBERS	· Illustrates division as a repeated subtraction process
	· Derives the basic division facts: twos through the the number of twos in 18; threes through the number of threes in 27; fours through the number of fours in 36; fives through the number of fives in 45
	· Writes and states the division facts related to the basic multiplication facts
FRACTIONAL NUMBERS	· Identifies halves, fourths, eighths, thirds, and sixths of a whole
	· Uses the fraction symbols 1/2, 1/4, 1/8, 1/3, 1/6

MATHEMATICS - GRADE 3 (Continued)

- Compares two fractions and explains the equal to, greater than, less than relationships

MEASUREMENT

- Identifies the penny, nickel, dime, quarter, half-dollar, and dollar, and indicates their value in cents
- Explains the relationships among penny, nickel, dime, quarter, half-dollar, and dollar
- Explains the relationships among day - week - month - year
- Tells time to the hour, half-hour, and quarter-hour
- Explains the relationship between minutes and hour
- Estimates length, capacity and weight
- Uses nonstandard units of measure
- Measures length and uses the metric units: meter, centimeter; the customary units: yard - foot - inch
- Measures weight and uses the metric units: kilogram, gram; the customary units: pound, ounce
- Measures capacity and uses the metric unit liter; the customary units: cup, pint, quart
- Recognizes the standard units for measuring temperature: ^{o}C (degree Celsius) and ^{o}F (degree Fahrenheit)

GEOMETRY

- Recognizes and names plane figures
- Describes similarities and differences of squares, rectangles, triangles, and circles
- Identifies examples of symmetries in objects or pictures and indicates line symmetries in each example

MATHEMATICS - GRADE 3 (Continued)

GRAPHS; PROBLEM SOLVING; PROBABILITY	• Collects, organizes and records data • Constructs, reads and discusses bar graphs • Creates word problems based on the graphic representation of data • Indicates the number operation needed for solving a simple verbal problem • Writes and solves an appropriate number sentence for a word problem

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 4

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER; NUMERATION .	· Recognizes numerals 0 to 10,000
	· Reads and writes the standard numeral and the word form for whole numbers through ten-thousands
	· Names the value of any digit in a four-digit numeral
	· Compares and orders whole numbers less than one-thousand
	· Estimates a quantity by rounding numbers to the nearest ten; to the nearest hundred
	· Recognizes numbers as odd or even
	· Reads and writes money values using dollar and cents notation
ADDITION OF WHOLE NUMBERS	· Recalls basic addition facts
	· Demonstrates the renaming (exchange) process in addition: ones for tens; tens for hundreds
	· Computes the sum of two or three numbers in the hundreds; in the thousands; where no renaming (exchange) is required
	· Computes the sum of two addends in the hundreds where renaming (exchange) in the ones and tens places is required
	· Estimates sums by rounding addends to the nearest ten or nearest hundred

MATHEMATICS - GRADE 4 (Continued)

	· Explains the reasonableness of a computed sum
	· Computes sums involving money values using dollar and cents notation
SUBTRACTION OF WHOLE NUMBERS	· Recalls basic subtraction facts
	· Demonstrates the renaming (exchange) process in subtraction: hundreds for tens; tens for ones
	· Computes the difference of three-place; four-place numbers where no renaming (exchange) is required
	· Computes the difference of three-place numbers where renaming (exchange) is required in the hundreds and in the tens place
	· Applies the principle of inverse operations to check a subtraction example
	· Computes differences involving money values using dollar and cents notation
	· Explains the reasonableness of a computed difference
MULTIPLICATION OF WHOLE NUMBERS	· Names the multiples of whole numbers zero through nine
	· Recalls the basic multiplication facts
	· Names the product of a whole number and one; of a whole number and zero
	· Demonstrates that the order in which two numbers are multiplied does not change the product
	· Multiplies ten and multiples of ten; one-hundred and multiples of one-hundred; by a one-place number
	· Computes the product of a two-place number; a three-place number; and a one-place number

MATHEMATICS - GRADE 4 (Continued)

- Computes products involving money values using dollar and cents notation

DIVISION OF WHOLE NUMBERS

- Illustrates the division process as repeated subtraction
- Recalls the basic division facts
- Recognizes multiplication and division as inverse operations
- Computes the quotient of a two-place number; of a three-place number by a number less than ten
- Explains the remainder
- Estimates quotients and explains the reasonableness of the answer

FRACTIONAL NUMBERS

- Identifies halves, fourths, eighths, thirds, sixths, fifths and tenths of a whole and uses the appropriate fraction symbols
- Compares and orders unit fractions with denominators of 2, 3, 4, 5, 6, 8, and 10
- Recognizes equivalent fractions for fractions with denominators of 2, 3, 4, 5, 6, 8, and 10
- Separates sets of objects into equivalent subsets and recognizes each subset as a fractional part of the whole set
- Explains and completes a number sentence involving a fractional part of a set of of objects, e.g., 1/2 of 8 = $\square$ (whole numbers multiples of denominators)
- Computes sums and differences of fractional numbers with like denominators; of mixed numerals with like denominators

MATHEMATICS - GRADE 4 (Continued)

MEASUREMENT

- Explains the relationship between: days - year; days - month; weeks - year
- Obtains information from a calendar
- Explains the relationships among day, hour, minutes, seconds
- Reads and tells time to the hour, to the half-hour, to the quarter hour, and in minute intervals
- Uses the time notation 3:04 when recording time
- Approximates and measures length, weight, capacity and temperature
- Uses the metric and customary standard units of length, weight and capacity
- Recognizes the relationship among the the standard units of length:
  centimeter - decimeter - meter - kilometer
  inch - foot - yard - mile
- Recognizes the relationships among the standard units of weight:
  gram - kilogram - metric ton
  pound - ounce - ton
- Recognizes the relationships among the standard units of capacity:
  liter - milliliter
  cup - pint - quart
- Distinguishes between freezing point and boiling point on the Celcius scale and the Fahrenheit scale
- Measures temperature with a Celsius; a Fahrenheit thermometer and records temperatures as ^{o}C (degree Celsius); ^{o}F (degree Fahrenheit)

MATHEMATICS - GRADE 4 (Continued)

GEOMETRY	· Recognizes and describes some basic characteristics of quadrilateral, triangle and circle
	· Recognizes and describes some characteristics of a rectangular solid, cylinder and cube
	· Describes and computes the perimeter of a square; a rectangle
	· Identifies the lines of symmetry in a figure
GRAPHS; STATISTICS; PROBLEM SOLVING; PROBABILITY	· Collects, organizes and records data
	· Constructs, reads and discusses bar graphs
	· Derives word problems and questions relevant to the bar graphs
	· Determines the number operation needed for solving a verbal problem
	· Writes the appropriate number sentence for a word problem
	· Solves word problems with extraneous information given
	· Solves word problems involving the basic number operations

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 5

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVE
NUMBER; NUMERATION	· Names the value of any digit in a six-digit numeral
	· Reads and writes the number word and the standard numeral associated with whole numbers through hundred-thousands
	· Compares two numbers less than one million and uses the correct relation symbol ($<, >, =$)
	· Rounds whole numbers to the nearest thousand
	· Recognizes and names the value of digits in the tenths place; in the hundredths place
	· Reads and writes decimal numerals through the hundredths
	· Explains the relationship between the decimal system and dollars and cents system
	· Compares and orders tenths ; hundredths
	· Rounds decimals to the nearest whole number
	· Recognizes equivalent decimals
ADDITION AND SUBTRACTION OF WHOLE NUMBERS	· Recalls the basic addition and subtraction facts
	· Estimates and computes the sum of two or more addends, sum less than one million
	· Estimates and computes differences of whole numbers less than one-million

MATHEMATICS - GRADE 5 (Continued)

	· Computes sums and differences involving money values using dollar and cents notation
	· Applies the principle of inverse operations to check subtraction
	· Applies the commutative property of addition
MULTIPLICATION OF WHOLE NUMBERS	· Recalls the basic multiplication facts
	· Names and writes the multiples of the numbers zero through nine; multiples of ten; multiples of one-hundred
	· Estimates and computes the product of: a five-digit number by a number less than ten; a three-digit number by a two-place number
DIVISION OF WHOLE NUMBERS	· Recalls the basic division facts
	· Estimates and computes the quotient of: a four-digit number by a number less than ten; a three-digit number by a two-digit number
	· Applies the principle of inverse operations to check division
FRACTIONAL NUMBERS: COMMON FORM; DECIMAL FORM	· Recognizes a fractional number as a division
	· Generates and reads equivalent fractions for fractions with denominators of 2, 3, 4, 5, 6, 8, and 10
	· Changes a mixed numeral to an improper fraction; an improper fraction to a whole number or a mixed numeral
	· Recognizes the fractional names for one
	· Finds a common denominator; the least common denominator

MATHEMATICS - GRADE 5 (Continued)

- Computes sums and differences of fractional numbers and of mixed numbers with like and unlike denominators
- Computes products of fractional numbers with denominators of 2, 3, 4, 5, 6, 8, 10; a whole number by a fractional number; a fractional number by a whole number
- Renames a decimal fraction as a common fraction with a denominator of 10 or 100
- Computes sums and differences using tenths; using hundredths

MEASUREMENT

- Approximates and measures perimeter, length, capacity and weight
- Measures and uses the standard units of length, weight and capacity
- Explains the relationships among the standard units of length:
  kilometer - meter - decimeter - centimeter-millimeter
  mile - foot- inch
- Explains the relationships among the standard units of weight:
  metric ton - kilogram - gram - milligram
  pound - ounce - ton
- Explains the relationships among the standard units of capacity:
  kiloliter - liter - milliliter
  ounce - cup - pint - quart - gallon
- Measures temperature and uses the standard units: degree Celsius (^{o}C); degree Fahrenheit (^{o}F)
- States the relationships between months - year; among seconds - minutes - hours; among days - weeks - months

MATHEMATICS - GRADE 5 (Continued)

GEOMETRY	· Explains the basic properties of quadrilateral, triangle, pentagon, circle
	· Distinguishes between perimeter and circumference
GRAPHS; STATISTICS; PROBLEM SOLVING; PROBABILITY	· Computes the average (mean) of a set of numbers
	· Solves word problems involving averages
	· Collects, organizes and records data
	· Constructs, reads and discusses bar and line graphs
	· Derives word problems and questions relevant to the bar and line graphs
	· Determines the number operation needed for solving a verbal problem
	· Writes the appropriate number sentence for a word problem
	· Solves word problems involving the basic operations with whole numbers, fractional numbers, decimals, and units of measure

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 6

After completing each topic the pupil should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER; NUMERATION	• Names the value of any digit in a seven-digit numeral
	• Reads and writes the number word and the standard numeral associated with numerals through 9,999,999
	• Compares any two numbers with up to seven digits and uses the correct relation symbol (>, <, a =)
	• Writes the expanded form of a four, five, or six-digit numeral
	• Rounds whole numbers to the nearest hundred-thousand; to the nearest million
	• Identifies and names the value of digits that are in the tenths place; in the hundredths place; in the thousandths place
	• Reads and writes the number word and the standard numeral associated with decimals
	• Compares and orders tenths; hundredths; thousandths
	• Writes equivalent decimals
	• Rounds decimals to the nearest whole number
	• Names the factors of a given whole number less than one-hundred
ADDITION AND SUBTRACTION OF WHOLE NUMBERS	• Recalls basic addition and subtraction facts

MATHEMATICS - GRADE 6 (Continued)

	• Estimates sums and differences
	• Computes and checks sums and differences involving whole numbers less than ten-millions
	• Computes sums and differences involving money values using dollars and cents notation
	• Solves word problems that involve addition
MULTIPLICATION OF WHOLE NUMBERS	• Recalls basic multiplication facts
	• Estimates products
	• Computes and checks the product of a two, three, or four-place number and a two-place number
	• Multiplies a one-place number by a multiple of ten, one-hundred, or one-thousand and recognizes a pattern
	• Computes products involving money values using dollars and cents notation
	• Solves word problems that involve multiplication
DIVISION OF WHOLE NUMBERS	• Recalls basic division facts
	• Estimates quotients
	• Computes the quotient for a dividend up to four-digits and a two-digit divisor
	• Divides by ten or a multiple of ten
FRACTIONAL NUMBERS: COMMON FORM; DECIMAL FORM	• Reads and writes equivalent fractions for fractions with denominators of 2,3,4,5,6,8, and 10
	• Changes a fraction to higher and lower terms
	• Recognizes which of two fractions is greater; is less
	• Changes a mixed number to a fraction
	• Changes a fraction equal to or greater than one to a mixed number or a whole number

MATHEMATICS - GRADE 6 (Continued)

- Finds a common denominator; the least common denominator
- Computes sums, differences and products of fractions and of mixed numbers with like and unlike denominators
- Computes sums and differences using tenths; hundreths
- Computes the product of:
  a whole number and tenths
  a whole number and hundredths
  tenths by tenths
- Solves word problems that involve multiplication and division with decimals (dollars and cents)
- Divides tenths and hundredths by a one place number
- Checks for reasonableness of answers

MEASUREMENT

- Measures length and uses the standard units: kilometer, meter, decimeter, centimeter, millimeter; mile, foot, inch
- Measures weight and uses the standard units: metric ton, kilogram, gram, milligram; ton, pound, ounce
- Measures capacity and uses the standard units: kiloliter, liter, milliliter; cup, ounce, pint, quart, gallon
- Measures temperature and uses the standard units: degree Celsus (^{o}C); degree Fahrenheit (^{o}F)
- Changes from one standard unit of measure to another unit of measure within the same system (metric or customary)
- Calculates the perimeter of polygons
- Calculates the area of rectangles and squares
- Calculates the volume of a rectangular prism

MATHEMATICS - GRADE 6 (Continued)

GEOMETRY	· Describes the basic properties of plane figures
	· Identifies common geometric solids
	· Describes the basic properties of rectangular prisms
GRAPHS; STATISTICS; PROBLEM SOLVING; PROBABILITY	· Computes the average (mean) of a set of whole numbers
	· Collects and represents data in the form of line, bar, or picture graphs
	· Answers questions about the graphs
	· Derives word problems relevant to the graphs
	· Translates a verbal problem into an appropriate number sentence
	· Determines the number operation(s) needed to solve a word problem
	· Distinguishes between necessary and unnecessary information in solving a word problem
	· Determines whether there is enough information to solve a word problem
	· Solves word problems that involve the basic operations with whole numbers, fractional numbers, decimals, and units of measure

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 7

After completing each topic the student should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER AND NUMERATION	· Names the value of any digit in a ten-digit numeral
	· Reads and writes the number word and the standard numeral associated with numerals through ten-billions
	· Reads and writes the exponential form for a standard numeral through 10^9
	· Rounds whole numbers to the nearest million
	· Determines the ratio of two quantities
	· Recognizes the symbols used for ratio
OPERATIONS AND APPLICATIONS WHOLE NUMBERS	· Estimates, computes and checks sums and differences
	· Estimates and computes the product of a whole number and a three-place number
	· Divides whole numbers by two-place divisors
	· Solves verbal problems involving the four basic operations with whole numbers
	· Develops an original word problem that fits a designated computation
	· Recognizes that a problem may have more than one solution
OPERATIONS AND APPLICATIONS FRACTIONAL NUMBERS	· Compares and orders fractions
	· Derives fractions equivalent to a given fraction
	· Changes a fraction to higher or lower terms

MATHEMATICS - GRADE 7 (Continued)

- Renames numbers written in mixed fractional form as improper fraction
- Changes a fraction equal to or greater than one to a mixed numeral or a whole number
- Names the multiples of a number
- Recognizes the common multiples; the least common multiple of a pair of numbers
- Names the reciprocal of a number
- Computes sums, differences, products and quotients of fractions and mixed numerals with like and unlike denominators of 2, 3, 4, 5, 6, 8, and 10
- Solves verbal problems involving the four basic operations with fractional numbers

OPERATIONS AND APPLICATIONS
DECIMALS; PERCENTS

- Reads and writes decimals through ten-thousandths in word form and in standard form
- Compares and orders decimals
- Estimates, computes and checks sums, differences, products and quotients of decimal numerals
- Solves verbal problems involving the four basic operations with decimals and money values
- Obtains and uses information about checking and savings accounts
- Solves problems involving budget, unit pricing, discounts, installment buying
- Explains the meaning of percent
- Recognizes the equivalence relationship among numbers expressed as fractions, decimals, ratios and percents
- Finds a given percent of a number; finds what percent one number is of another

MATHEMATICS - GRADE 7 (Continued)

- Solves problems involving simple interest, rates, sales tax, discount, salary, commission, profit and loss
- Recognizes ratios, rates and their uses

GEOMETRY AND MEASUREMENT

- Recognizes congruence
- Determines whether two lines are parallel, perpendicular, or intersecting (not perpendicular)
- Classifies and names polygons by the number of sides
- Classifies and names triangles and quadrilaterals according to their properties
- Recognizes acute, obtuse, right and straight angles
- Explains the basic properties of a rectangular prism, cube, cylinder
- Recognizes and describes the circle and related parts: center, radius, diameter, central angle, arc, chord, semicircle
- Explains the relationship between radius and diameter; diameter and circumference
- Uses a protractor to measure angles and states the measure in degrees
- Computes the area of a rectangle; of a square
- Computes the volume of a rectangular prism; of a cube
- Calculates the circumference of a circle
- Calculates the perimeter of a plane figure
- Estimates measurements using nonstandard and standard units
- Selects the appropriate metric and customary units to use for expressing measurements

MATHEMATICS - GRADE 7 (Continued)

- Measures length, weight, capacity and temperature using the metric and the customary units
- Recognizes the common metric prefixes and explains the relationships among them
- Computes with metric and customary measures and makes conversions within the metric system or within the customary system

ALGEBRAIC CONCEPTS

- Translates verbal problems into mathematical sentences
- Derives a table of values from a formula
- Solves equations such as:
  $x + 4 = 12$ $x - 5 = 3$ $3x = 15$

GRAPHS AND STATISTICS

- Computes the mean, the median and the mode
- Reads and interprets data from line graphs, bar graphs, circle graphs, and pictographs
- Collects and organizes data in the form of a line graph; bar graph

OPERATIONS AND APPLICATIONS:

- Uses integers to describe number situations
- Compares and orders integers
- Explains the addition of integers on the number line
- Computes the sum of two integers

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - GRADE 8

After completing each topic the student should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVES
NUMBER AND NUMERATION	· Names the value of any digit in a twelve-digit numeral
	· Reads and writes the number word and the standard numeral associated with numerals through hundred billions
	· Reads and writes the exponential form for a standard numeral through 10^{11}
	· Rounds whole numbers to the nearest billion
	· Names factors of whole numbers to one-hundred
	· Applies tests for divisibility by 2, 5, and 10, mentally
	· Indicates the greatest common factor of two numbers
	· Classifies a number as prime or composite
OPERATIONS AND APPLICATIONS; WHOLE NUMBERS	· Estimates, computes and checks sums, differences, products and quotients
	· Solves verbal problems involving the four basic operations with whole numbers
	· Selects the appropriate operation(s) to solve a verbal problem
OPERATIONS AND APPLICATIONS; FRACTIONAL NUMBERS	· Compares and orders fractional numbers
	· Changes fractions to equivalent fractions

MATHEMATICS - GRADE 8 (Continued)

- Changes a fraction to higher and lower terms
- Names the reciprocal of a number
- Computes sums, differences, products and quotients of fractions and of mixed numerals with like and unlike denominators of 2, 3, 4, 5, 6, 8, and 10
- Solves verbal problems involving the four basic operations with fractional numbers

OPERATIONS AND APPLICATIONS; DECIMALS

- Reads and writes decimals through ten-thousandths; hundred-thousandths in word form and in standard form
- Recognizes the equivalence relationship between decimals and fractional numbers
- Compares and orders decimals
- Changes decimals to fractions and vice versa
- Distinguishes between terminating and repeating decimals
- Estimates, computes and checks sums, differences, products and quotients of decimal numerals
- Uses the dollars and cents system by completing basic banking forms
- Uses unit pricing to identify the better buy
- Solves verbal problems involving the four basic operations with decimals and money values
- Checks for reasonableness of answers

OPERATIONS AND APPLICATIONS; PERCENT; RATIO; PROPORTION

- Explains the meaning of percent
- Changes percent to equivalent fractions and decimals and vice versa

MATHEMATICS - GRADE 8 (Continued)

- Computes the percent of a number in problems involving discount, sales tax, and simple interest
- Computes what percent one number is of another in verbal problems
- Computes installment prices, money earned, and commission
- States and writes the ratio of one quantity to another
- Expresses arithmetic and geometric information in ratio form
- Recognizes a proportion expression
- Uses cross products in a proportion to solve problems
- Recognizes and gives examples of rates
- Solves problems involving ratios, rates and proportions

GEOMETRY AND MEASUREMENT

- Identifies and classifies different types of lines, angles, triangles, and quadrilaterals according to their measures or position
- Recognizes congruent figures
- Uses measurement tools, e.g., ruler, protractor
- Computes perimeter, area and volume of geometric figures using metric and customary units
- Measures length, weight, capacity, and temperature using the metric and the customary units
- Computes with metric and customary measures and makes conversions within the metric system or within the customary system

ALGEBRAIC CONCEPTS: EQUATIONS AND INEQUALITIES

- Uses the inequality symbols to compare numbers

MATHEMATICS - GRADE 8 (Continued)

- Translates verbal problems into mathematical sentences
- Solves simple algebraic equations, e.g.
  $x + 7 = 12$ $2x + 1 = 9$
- Locates points on a number line
- Uses formulas to solve problems from science and career areas
- Recognizes and explains functional relationships
- Uses flow charts in solving problems

OPERATIONS AND APPLICATIONS; INTEGERS, ROOTS

- Recognizes positive and negative numbers
- Compares and orders positive and negative numbers
- Names the sum of two integers
- Relates subtraction of integers to temperature change

STATISTICS; PROBABILITY

- Recognizes the probability of an event, including a probability of zero or one
- Expresses probability as a ratio
- Computes the arithmetic mean (average), median and mode

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - 9th YEAR PRE-ALGEBRA

After completing each topic the student should be able to meet the following objectives.

TOPIC	PERFORMANCE OBJECTIVE
WHOLE NUMBERS AND INTEGERS	· Reads and writes the number word and the standard numeral associated with numbers through trillions
	· Identifies the value of any digit in a numeral
	· Names the whole number represented by an expression involving exponential notation
	· Writes powers of ten in exponential form
	· Rounds numbers
	· Estimates, computes, and checks sums, differences, and products of whole numbers
	· Estimates, computes, and checks the quotient of whole numbers when the divisor is less than one-hundred
	· Identifies a number as prime or composite
	· Recognizes positive and negative numbers
	· Uses integers to represent values above and below zero
	· Names the sum of two integers
FRACTIONS AND DECIMALS	· Compares and orders fractions
	· Changes fractions to equivalent fractions
	· Expresses fractions in lowest terms

MATHEMATICS - 9th YEAR PRE-ALGEBRA (Continued)

- Names the least common denominator, when LCD is 20 or less
- Adds and subtracts with fractions and mixed numerals with denominators of 2, 3, 4, 5, 6, 8, and 10
- Multiplies and divides with fractions and mixed numerals
- Names the place value of digits to the right of the decimal point
- Reads and writes decimals through thousandths in word form and in standard form
- Compares and orders decimals
- Changes fractions to equivalent decimals
- Writes equivalent decimals, e.g., .4 = .40
- Performs the operations of addition, subtraction , multiplication, and division with decimals and dollars and cents

RATIO; PROPORTION; PERCENT

- Writes ratios and equivalent ratios
- Describes proportion
- Uses cross products to solve proportions
- Uses the scale on a map to determine the distance between points
- Explains percent
- Computes the percent of a number; computes what percent one number is of another
- Converts fractions, mixed numerals, and decimals to percents; changes percents to fractions, mixed numerals, and decimals
- Recognizes the relationship among equivalent fractions, decimals and percents,

MATHEMATICS - 9th YEAR PRE-ALGEBRA (Continued)

	and uses it to solve problems
	. Solves problems involving simple interest, discount, commission, sales tax, installment buying
	. Selects the appropriate operation(s) to solve verbal problems
	. Checks for reasonableness of an answer
GEOMETRY AND MEASURMENT	. Identifies and classifies: lines, angles, triangles, quadrilaterals
	. Recognizes and names the parts of a circle
	. Identifies: rectangular solid, cube, cylinder, cone, sphere, pyramid
	. Computes the perimeter of a polygon; the circumference of a circle
	. Uses a protractor to measure angles and states the measure in degrees
	. Computes the area of a rectangle, square, triangle, circle
	. Calculates the volume of a rectangular prism; of a cube
	. Measures length, weight, capacity, and temperature using the metric and the customary units
	. Computes with metric and customary measures and makes conversions within the metric system or within the customary system
	. Solves verbal problems involving length, area, volume, time, weight, and temperature
EQUALITIES AND THEIR GRAPHS	. Solves simple equations, e.g. $2x + 1 = 9$ $x - 34 = 42$
	. Writes, evaluates and interprets formulas

MATHEMATICS - 9th YEAR PRE-ALGEBRA (Continued)

- Locates and names points on a number line
- Locates and names points in the plane using ordered number pairs

PROBABILITY; STATISTICS; AND GRAPHS

- Collects, organizes, and interprets data
- Reads and interprets line, bar, circle graphs and pictographs
- Computes the average (arithmetic mean) of a set of numbers
- Explains probability
- Computes the probability of outcomes of simple events

CONSUMER AND BANKING SKILLS

- Uses unit pricing to indicate the best buy
- Applies mathematics to consumer skills needed for buying and selling, comparison shopping, savings and checking accounts, computing income and wages
- Reads and interprets maps, charts, phone, utility and postal rate tables

MINIMUM STANDARDS OF PUPIL PERFORMANCE

MATHEMATICS - 9th YEAR (ALGEBRA)

After completing each topic the pupil should be able to meet the following objectives:

TOPIC	PERFORMANCE OBJECTIVES
SYMBOLS IN MATHEMATICS	· Recalls the symbols of operation; of comparison
	· Describes the order of operation
	· Uses the accepted order of operations in computation
	· Recalls the meaning and use of an open sentence, a variable, and a replacement set
	· Translates English phrases into mathematical expressions and open sentences
	· Evaluates formulas and algebraic expressions
RATIONAL NUMBERS: OPERATIONS AND PROPERTIES	· Adds, subtracts, multiplies and divides with signed numbers
	· Describes and uses the additive identity and the additive inverse for signed numbers
	· Describes and applies the distributive property of multiplication over addition to signed numbers
	· Describes and uses the multiplicative identity and the multiplicative inverse for signed numbers
	· Explains and applies the zero property of multiplication
LINEAR EQUATIONS IN ONE VARIABLE	· Translates verbal phrases and sentences into equivalent expressions using mathematical symbols

MATHEMATICS - 9th YEAR (ALGEBRA) Continued

- Formulates the meaning of equivalent equations and inequalities
- Uses equations to solve problems involving percent
- Recognizes that mathematical formules are equations
- Applies the principles of equations to transforming formulas
- Uses the distributive property to solve equations
- Solves simple number problems

POLYNOMIALS

- Recalls the meaning of coefficients, factors and exponents
- Identifies a polynomial; a monomial; a binomial
- Relates polynomial expressions to numerals in expanded form
- Evaluates polynomial expressions
- Adds, subtracts and multiplies with polynomials
- Explores the properties of exponents, e.g. $a^m \cdot a^n = a^{m+n}$
- Simplifies the members of an equation
- Solves perimeter problems

EQUATIONS AND INEQUALITIES

- Solves equations with variables on both sides of the equal sign
- Solves uniform motion problems which involve motion in opposite directions

  Solves uniform motion problems of the overtake and round trip types

MATHEMATICS - 9th YEAR (ALGEBRA) Continued

	. Explains the meaning and solution of inequalities
DIVISION OF POLYNOMIALS	. Divides a monomial by a monomial; a polynomial by a monomial; a polynomial by a binomial; a polynomial by a binomial, with a remainder
SYSTEMS OF EQUATIONS AND GRAPHS	Graphs the solution of sets of linear equations in two variables
	. Solves graphically pairs of equations and inequalities
	. Expresses the conditions of number, mixture, business, and investment problems as a system of linear equations in two variables
	. Solves problems involving numbers and digits, mixture, and investment
	. Solves pairs of equations by any algebraic method
FACTORING AND QUADRATIC EQUATIONS	. Recognizes the relationships between polynomial products and their factors
	. Factors binomials and trinomials
	. Multiplies two binomials by inspection
	. Factors trinomials of the form $ax^2 + bx + c$ where $a = 1$; where $a > 1$
	. Identifies a quadratic equation
	. Solves quadratic equations
	. Solves area problems which involve the solution of quadratic equations
ALGEBRAIC FRACTIONS	. Uses factoring to simplify algebraic fractions
	. Performs the four basic operations upon algebraic fractions

	. Solves equations involving algebraic fractions
	. Solves work and number problems involving equations with fractions
THE REAL NUMBERS	. Defines rational numbers, irrational numbers, and real numbers
	. Associates integers, rational numbers, and irrational numbers ($\sqrt{2}$ and π) with points on a line
	. Explains the meaning of square root
	. Computes, square root by approximation
	. Describes and applies the Pythagorean Theorem
	. Uses square root in Pythagorean situations
	. Simplifies radicals
	. Multiplies and divides radicals
	. Adds and subtracts radicals
RATIO; PROPORTION; AND INDIRECT MEASUREMENT	. Expresses relationships in terms of ratio and proportion
	. Solves ratio and proportion problems using algebraic methods
	. Describes similar triangles
	. Solves problems involving similar triangles by indirect measurement
	. Explains trigonometric ratios: sine, cosine, tangent
	. Selects an appropriate trigonometric ratio and uses it to solve problems